DOCUMENT RESUME

ED 215 883 SE 037 074

AUTHOR Nik Pa, Nik Azis B.
TITLE A Bibliography of Articles on Fractions.
PUB DATE 13 Nov 81
NOTE 32p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Annotated Bibliographies; Basic Skills; Elementary Secondary Education; *Fractions; Learning Activities; Mathematics Curriculum; *Mathematics Education; *Mathematics Instruction; Number Concepts; *Reference Materials

ABSTRACT

This document lists references on the teaching of fractions, with many of the entries annotated. They are alphabetized by the author by categories: Activity and Game; Addition and Subtraction; Teaching Aids; Application; Assessment; Curriculum; Decimal; Common Fraction; Division; Equivalence of Fractions; Errors; Fraction Concept; Multiplication; Rate and Ratio; Research; and Teaching. (MP)

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A BIBLIOGRAPHY OF ARTICLES ON FRACTIONS

by

Nik Azis B. Nik Pa
Department of Mathematics Education
University of Malaya
Kuala, Lumpur
Malaysia

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A Bibliography of articles on fractions

Fractions occupy an important place in school mathematics programes. According to the survey of the Priorities in School Mathematics Project (1981), four major goals of teaching fractions are related to; (a) their use in vocation, (b) consumer purchases, (c) illustrating basic mathematical ideas and (d) providing solution to algebraic equations. The teaching of fractions has always been a challenge to teachers in all grades. That it continues to be a challenge is attested to by the recent report of the National Assessment of Educational Progress (1980). According to this report, 13-, and 17- year-olds students find fractions to be a difficult topic. Although many of them can successfully apply an algorithm, they have little understanding of the underlying concepts and processess. Students appear to be learning many mathematical skills at the rote manipulative level. In this article a series of bibliography that involved activity and game, addition and subtraction, teaching aids, application, assessments, curriculum, decimals, division, errors, equivalent fractions, fraction concept, multiplication, rate and percent, research and teaching of fractions will be presented. It is the hope of the author that teachers of mathematics who want to emphasize meaning and understanding prior to intensive work with formal algorithms involving fractions will find some of these articles useful.

To conserve space, abbreviations are used for some of the titles of the peroidicals in the list itself.Full titles are listed below:

AMM American Mathematical Monthly

AT Arithmetic Teacher

DA Dissertation Abstracts

DAI Dissertation Abstracts International.

ESJ Elementary School Journal

GT Grade Teacher

JER Journal of Educational Research

JRME Journal for Research in Mathematics Education.

MT Mathematics Teacher

SSM School Science and Mathematics.

Activity and game

Albuquerque, H. D.. Fraction action-gameboard route helps kids compute. Learning, 1978, 2, 84.

Armstrong, C.. Fradecent- a game using equivalent fractions, decimals, and percents. AT, 1972, 3, 222-223.

Bradfield, D. L.. Sparking interest in the mathematics classroom. AT, 1970, 3, 239.

Carlisle, E.. Crazy fractions:An equivalence game. AT, 1973, 4, 303-304.

Cook, Nancy. Fraction bingo. AT, 1970, 3, 237-239.

Reese, J.W.. Yardstick game. Instructor, 1970,11,36.

Staritzky, M.. Pass a fraction. Instructor, 1973, 84.

Zytkowski, R.T.. A game with fraction numbers. AT, 1970,1,82-83.

Addition and Subtraction

Adachi, Mitsuo. Addition of unlike fractions. AT,1968,3,221-223.

Beacker,A. L.. Remedial work in the addition of common fractions. California Journal of Elementary Education, 1940,9,43-47.

He found that about one-third of the errors made by sixth grade students in addition of fractional numbers were attributable to equivalent fractions.

Burns, M.. The Math connections is yours to make. Learning, 1979,1,69-70.

Carmony, L.. Adding fractions incorrectly?. AT,1978,12,737-738. The author discusses an excaption to an established rule for adding two fractions.

Ellerbruch, L.W. & Payne, J.N.. A teaching sequence from initial concepts through the addition of unlike fractions. In the Developing Computational Skills, 1978 Yearbook of the National Council of Teachers of Mathematics. Reston Virginia: The Council,1978.

Lappan,G. & Winter, M.J. Some problems with fractions for the middle school. MT,1981,2, 102-104.

May, Lola. Adding and subtracting rational numbers. GT, 1968, 2,74-81.

Pigge, F.L. An experimental comparison of three methods of teaching addition and subtraction of fractions in grade five. DA, 1964, 25, 1789-1790.

Thiessen, D. David's algorithm for the L.C.D. AT,1981, 3, 18.

Teaching Aids

Ashlock, R.B.. Introducing decimal fractions with the meterstick. AT, 1976,3, 201-206,

Bennet, A.B.;& Davidson, P. S.. Fraction Bars. Palo Alto, California: Creative Publications, 1980.

Bohan, H. Paper folding and equivalent fractions-bridging a gap. AT, 1971,1, 245-249.

Bright, George. Ideas. AT, 1977, 1, 43-50.

Brown, C. N.. Fractions on grid paper. AT,1979, 1, 8-10.

Bruni, J.V..& Silverman, H.J.. Using indoor games to motivate mathematics learning. AT, 1976, 3, 154-162.

Bruni, J.V.;&Silverman H.J.. Using rectangles and squares to develop fraction concepts. AT, 1977,2, 96-102.

Burus, M. Computation activities that make connections. Learning, 1979, 1, 71-75.

Byrad, D.S.. Freaky fraction kit. Teacher, 1972,9, 76-77.

Calson, R.G.Multiplication of rate pair: a rationale for unit analysis. SSM, 1970, 4, 313-320.

Carlisle, E.. Fractions and popsicle sticks. AT, 1980, 2, 50-51.

Cunningham, G. & Raskin, D.. The pegboard as a fraction maker. AT, 1968, 3, 224-227.

Dana, M.E.. & Lindquist,M.M.. From halves to hundredths. AT, 1978, 11,4-8.

Davis, E.J.. A model for understanding in mathematics. AT, 1978, 9, 13-17.

Dirkes, M. A.. Say it with pictures. AT, 1980, 11, 10-12.

Green, G.. Fold your way into fractions, Instructor, 1977.

Green, G.. A model for teaching multiplication of fractional numbers, A , 1973, 1, 5-12.

Hannan, H.. Sets aid in adding fractions. AT, 1959, 2, 35-38.

Hertz, P.. Manipulative devices in lower grades, AT, 1951, 11, 214-216.

Hyde, D. and Nelson, M.. Save those egg cartons! AT, 1967, 11, 578-579.

Jacobson, R.. Fun with fractions for special education. AT, 1971, 10, 417-419.

Jeanine, M.. Renaming fractions greater than one. Catholic School Journal, 1966, 4, 72.

Leutzenger, L.P. & Nelson, G. Fractions with models. AT, 1980, 5, 6 - 11.

Litwiller, B. H. & Ducan, D.. Fraction action. Teacher, 1977,12, 47.

Sanders, W. J.. The use of models in mathematics instruction. AT,1964, 3, 157 - 165.

Sanok, G,. Mathematics and saltine crackers. AT, 1980, 12, 36.

Schiller, D. P.. The effects of the fraction ruler manipulative for teacher computation of fractions. The Clearing House, 1977, 3, 300 - 303.

Scott, W. Fractions taught by folding paper strips. AT,1981, 1, 18-21.

Sherill, J.M.. Egg cartons agains ?! AT, 1973, 1, 13 -14.

Sherman, H. Fractions over easy. Teacher, 1978, 9, 139-142.

Sowder, L. Models for fractional numbers-a quiz for teachers. AT, 1971, 1, 44 -46.

Sowder, L.. Criteria for concrete models. AT,1976, 10, 468 - 470.

Sprau, D. From the file:Fractions. AT,1980,12, 44.

Van de Walle, J. & Thompson, C.S.. Fraction with counters. AT,1980, 9, 6 - 11.

Vochko, L.E. Manipulative Activities and Games in the Mathematics Classroom, Washington: National Education Association, 1978, 43-45.

Watkins, A.E. and Watkins, U. Fractions on the geoboard. MT, 1980, 2, 133-139.

West, T. Some mathematical hard spots. AT, 1978, 9, 19-23.

Application

Beynen, J.V. and Mc Ginty, R.L. A geometric interpretation of series. MT,1981, 3, 218- 220.

Ercalano, J. Fractional computation on a calculator. MT, 1979, 11, 591-592.

Knill, G. Fingerprints and fractions. MT,1980, 11, 608-609.

Maras, I.V.Fractions in metric countries. MT, 1980, 4, 246.
The author found that in countries where metric system are large amount of class times were spent on the teaching of fractions.

Mendoza, L.P. Using dice: from place value to probobality. AT, 1981, 4, 10-12.

Molley, G.H. Improper fractions. MT,1980, 4, 247.

Moore, C.G. An introduction to continued fraction. National Council of Teachers of Mathematics, 1964.

Olds, C.D. Continued Fractions New York: Random House, 1963.

Spieler, R.R. From the file:Fraction. AT,1981,1,49.

Thornton, C.A. A glance at the power of pattern. AT,1977,2,154-157.

Williams, G.A. The pythagoras theorem: a useful geometric tool for approximating $\sqrt{2}$. AT,1977, 4, 284-286.

Assessment

Carpenter, T.P.; Coburn,T.G.; Reys,R.E. and Wilson,J.W. Result and implications of the NAEP mathematics assessment: Elementary School. AT, 1975, 10, 438-450.

Carpenter, T.P.; Coburn,T.G.; Reys, R.E. and Wilson, J.W. Notes from national assessment: addition and multiplication with fractions AT,1976, 2, 137-142.

Carpenter, T. P.; Coburn, T.G.; Reys, R.E. and Wilson,J.W. Results From the First Mathematics Assessment of NAEP. Reston, Virginia: National Council of Teachers of Mathematics, 1978.

Carpenter, T.P.;Corbitt,M.K.; Kepner, H.S.; Lindquist,M.M.; and Reys, R. Results of the second NAEP mathematics assessment: elementry school. AT, 1980, 4, 10-12, 44-47.

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M. and Reys, R. Results of the second NAEP mathematics assessment: secondary school. MT, 1980, 5, 329- 338.

Post, T.R. Fractions: Results and implications from national assessment. AT, 1981, 5, 26-31.

Curriculum

Botts, T. Fractions in the new elementry curriculum. AT, 1968, 3, 216 - 220.

Cathcart, W.G. Metric measurement: Important curriculum consideration. AT, 1977, 4, 158-160.

In one part of the article the author discusses the role of common fractions with the implementation of the metric system of measurement.

Easterday, K.E.. A technique for low achievers. MT, 1965, 10, 519-521.

Engen, H.. Rate pairs, fractions and rational numbers. AT, 1960, 12, 389-399.

Firl, D.H.. Fractions, decimals and their future. AT, 1977, 3, 238-240.

The author believed that some basic computations with decimal should be taught earlier, while teachers did not have to be in a hurry to teach fractions until the junior high school.

Latino, J.J.. Take the folly out of fractions. AT, 1955, 2, 113-118.

Wilson, G.M. and Dalrymple, C.O.. Useful fractions. American Journal of Educational Research, 1937, 1, 341-347.
They found that common usage of fractions was limited to halves, thirds, quarters, eights and twelfths.

Wolfe, M and Braunfeld, P. Fractions for low achievers. AT, 1966, 12, 647-655.

Usiskin, Z.. The future of fractions. AT, 1979, 1, 18-20.

Decimal

Alexander, F.D.. One small jump--into repeating decimals and prime numbers. MT, 1974, 10, 520-525.

Anderson, J.T.. Periodic decimals. MT, 1974, 10, 504-509.

Burris, C.H. and Hobbs, B.F.. Minicalculators and repeating decimals. AT, 1978, 4, 18-20.

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M. and Reys, E.E.. Decimals: Results and implications from National Assessment. AT, 1981, 4, 34-37.

Faires, D.M.. Computation with decimal fractions in the sequence of number development. DA, 1963, 5, 23, 4183.

Flournoy, F.A.. A consideration fo pupils' success with two methods for placing the decimal point in the quotient. SSM, 1959, 6, 445-

Hilferty, M.M.. Some convenient fractions for work with repeating decimals. MT, 1972, 3, 240-241.

Hobbs, B.F. and Burris, C.H.. Minicalculators and repeating decimals. AT, 1978, 4, 18-20.

Hutchinson, M.R.. Investigation the nature of periodic decimals. MT. 1972, 325-327.

Jacobs, N.. More on repeating decimals. MT, 1975, 3, 249-252.

Kidder, F.R.. Ditton's Dilemma, on what to do about decimals. AT, 1980, 10, 44-46.

Leavitt, W.G.. A theorem on repeating decimals. The American Mathematical Monthly, 74: 669-673.

Margaret, H.. Some convenient fractions for work with repeating decimals. MT, 1972, 3, 240-241.

Prielipp, R.W.. Decimals. AT, 1976, 4, 285-288.

Rao, K.S.. Notes on the recurring period of the reciprocal of an odd number. The American Mathematical Monthly, 62: 484-487.

Rodidoux, D. and Montefusco, N. An easy way to change repeating decimals to fractions. - Nick's method. AT,1977,1,81-82.

Sgroi, J.J. Patterns of repeating decimals: A subject worth repeating. MT,1977, 604-605.

Wagner, S.S. Fun with repeating decimals. MT, 1979, 209-212. She generates repeating decimals with a cyclic pattern.

Woodburn, D. Can you predict the repeated? MT, 1976, 675-678.

Common Fraction

Johnson, J.T. Decimal versus common fraction. AT, 1956,11,201-203.

Kolesnik, T.S. The division of common fractions. AT, 1960, 3, 133-134.

Kolesnik, T.S. Illustrating multiplication and division of common fractions. AT, 1963, 5, 268-271.

Matthews, W.N. Teaching comparison of common fractions. AT, 1968, 3, 271-273.

Pickering, M.A. An investigation of children's learning of some concepts and principles which enable them to perform examples of addition of common fractions. DA, 1969, 4, 29A, 3533.

Division

Alkire, E.R. An experimental study of the value of a meaningful approach to the operation of division with common fractions. Unpublished Master's thesis, Claremont College, 1949.

Bergen, P. Action research on division of fractions. AT, 1966, 4, 293-295.

Bidwell, J.K. Some consequences of the learning theory applied to division of fractions. SSM, 1971, 5, 426-434.

Bray, C. J.. To invert or not to invert. AT, 1963, 5, 274-276.

Brickman, B. More rationalizing division of fractions. AT, 1955, 2, 25-26.

Brooke, G.M. The common denominator method in the division of fractions. DA, 1954, 14, 2290-2291.

Brueckner, L.J. and Melbye, H.O. Relative difficulty of types of examples in division with two-figure divisors. JER, 1940, 33, 401-414.

Capps, L.R. Division of fractions. AT, 1962, 1, 10-16.

Capps, L.R. A comparison of the common denominator and inversion method in teaching division of fractions. DA, 1960, 21, 819-820.

Christofferson, H.C. Division by a fraction made meaningful. MT, 1948, 9, 32-35.

Constantine, D.G. An approach to di ision with common fractions. AT, 1968, 2, 196.

Cornelia, N.J. Understanding division of fraction. Journal of Bussiness Education, 1966, 1, 157-158.

Dickey, J.W. Experimanting with apparatus in teaching division of fractions. National Elementry Principal, 1937, 7, 419-426.

Dilley, C.A. and Rucker, W.E.. Division with common and decimal fractional numbers. AT, 1970, 5, 438-441.

Donnell, W.J. Dividing fraction. MT, 1980, 12, 648.
He discusses a special way of dividing fractions.

Duker, Sam. Rationalizing division of fractions. AT, 1954, 11, 20-23.

Eagle, E.. Don't let that division become mysterious. AT, 1954, 10, 15-17.

Freeman, W.. Mrs. Murphy's pies - an introduction to division by fractions. AT, 1967, 4, 310-311.

Fromewick, A.. Nathan's conjecture. AT, 1973, 4, 289.

Greatsinger, C.. An experimental study of programmed instruction in division of fractions. DA, 1967, 27, 2442A.

Grossnickle, F.E.. How to use a fractional division. Journal of Education, 1954, 10, 17-19.

Hannon, H.. All about division with rational numbers -- variation on a theme. SSM, 1971, 6, 501-507.

Johnson, H.C.. Division with fractions: levels of meaning. AT, 1965, 5, 362-368.

Junge, Charlotte, W.. Now try this -- division of fractions. AT, 1968, 2, 177-178.

Koenker, R.H.. Dividing by a fraction. AT, 1965, 3, 225-226.

Koenker, R.H.. Certain characteristic differences between excellent and poor achievers in two-figure division. JER, 1942, 4, 578-586.

Krich, P.. Meaningful vs. mechanical method teaching division of fractions by fractions. SSM, 1964, 11, 697-708.

May, Lola. Division of fractional numbers can be meaningful. GT, 1968, 4, 64-72.

Mc Meen, G.H. Division of a fraction - a new method. AT, 1962, 3, 122-126.

Olberg, R. Visual aid for multiplication and division of fractions. AT, 1967, 44-46.

Riedesel, A. and Shryock, A.J. The use of the common denominator and the reciprocal in dividing fractions. SSM, 1964, 1, 53-59.

Sluser, T.A. A comparative study of division of fractions in which an explanation of the reciprocal principle is the experimental factor. DA, 1963, 23, 4624.

Stephens, L.E.. Retention of skill of division of fraction. AT, 1960, 1, 28-31.

Stephens, L.E. A comparative study of procedures used in teaching division of fractions in sixth grade arithmetic. Unpublished Master's thesis, University of California at Los Angeles, 1957.

Thompson, C. Teaching division of fractions with understanding. AT, 1979, 1, 24-27.

Zeddies, M.L. Creativity in general mathematics. MT, 1981, 3, 187. In one part of the article the author illustrates a rather strange way of quickly dividing fractions.

Equivelence of fractions.

Bohan, H. A study of the effectiveness of three learning sequences for equivalent fractions. DAI, 1971, 31, 6270A.

Brown, C.K. A study of four approaches to teaching equivalent fractions to fourth-grade pupils. DAI, 1973, 33, 3465A.
In this study four approaches to teaching of equivalent fractions to fourth graders yield the results that a textbook approach was inferior to 3 other approaches: the textbook with film, textbook with manipulatives, and textbooks with film and manipulatives. He also found that the textbook-film-manipulative approach yield significantly higher mean scores than the other three approaches.

May, Lola. Display fractions. GT, 1970, 12, 66-67.

Muderman, H.D. Evenness and oddness extended. AT, 1978, 3, 56.

Wood, W.S. A different way of finding fractional equivalents. MT, 1980, 10, 514-516.

Errors

Aftreth, O.B. The effect of the systematic analysis of errors in the study of fractions at the sixth grade level. JER, 1958, 9, 31-34.

Brueckner, L.J. Analysis of errors in fractions. ESJ, 1928, 6, 760-770.

Brueckner, L.J. Analysis of difficulties in decimals. ESJ, 1928, 29, 32-41.

Brueckner, L.J. Persistency of error as a factor in diagnosis. Education, 1935, 11, 140-144.

Clements, M.A. Analyzing childre's errors on written mathematical tasks. Educational Studies in Mathematics, 1980, 2, 1-21.

Gardner, P. Analysis of errors in fractions. In Studies in Arithmetic (vol 2) Edinburgh, Scothland: Scottish-Council for Research in Education, 1941.

Grossnickle F.E.. Types of errors in division of decimals. ESJ, 1941, 11, 184-194.

Grossnickle, F.E.. Kinds of errors in division of decimals and their constancy. JER,1943, 9, 110-117.

Guiler, W.S. Difficulties in fractions encountered by ninth-grade pupils. ESJ, 1945, 11, 146-156.

Guiler, W.S.. Difficulties in decimals encountered by ninth-grade pupils. ESJ, 1946, 3, 384-393.

Guiler, W.S. Difficulties in percentage encountered by ninth-grade pupils. ESJ,1946, 6, 563-573.

Hopkins, M.H. The diagnosis of learning styles in arithmetic. AT,1978, 4, 47-50.

Kallau, A.W.. Analysis and testing in common fractions. JER, 1920, 3, 177-192.

Laursen, K.W.Errors in first year algebra. MT,1978, 3, 194-195.

Morton, R.L. An analysis of pupil's errors in fractions. JER, 1924, 2, 117-125.

Pecks, D.M. and Jencks, S.M.. What the tests don't tell. AT, 1974, 1, 54-56.

Ranharter, H.K. and Johnson, H.C. Methods of attack used by good and poor achievers in attempting to correct errors in six types of subtraction involving fractions. JER, 1949, 4, 588- 597.

Sounder, H.C. The construction and evaluation of certain readiness tests in common fractions. JER, 1943,10,127-134.

Fraction concept

Brumfiel, C. Mathematical systemsand their relationships to the real world. AT, 1970, 11, 563-573

Bruni, J.V. and Silverman, H. An introduction to fractions. AT, 1975, 11, 538-545.

Campbell, B.G. The child's understanding of three interpretations of certain unit fractions prior to formal instruction. DAI, 1975, 35, 4855A.

Coxford, A.F. and Ellerburch, L.W. Fractional numbers. In Mathematics Learning in Early Childhood, Thirty-seventh Yearbook of National Council of Teachers of Mathematics. Reston, Virginia: The Council, 1975, 192-203.

Duquette, R.J. Some thoughts on Piaget's finding and the teaching of fractions. AT,1972, 4, 273-275.

Gibb, E.G. Fractions. GT, 1962, 4, 54.

Gunderson, A. and Gunderson, E. Fraction concepts held by young children. AT,1967, 4, 52-54.

Gunderson, E.. Fractions - seven-year-olds them. AT, 1958, 5,233-238.

Hall, J.V. A self-starter approach to fractions. MT, 1950, 11, 331-333.

Hannon, H. Concept determines process- a look at the fraction symbol. AT, 1966, 4, 298-302.

Hartung, M.L. Fractions and related symbolism in elementry-school instruction. ESJ,1958, 4, 377-384.

Howard, C.F. Three methods of developing children's concepts of fraction in grades V and VI of the elementry school. Unpublished doctoral dessertation, University of California at Berkeley, 1947.

He found that none of the three methods: drill approach, meaning approach, and combination approach was superior but on long term memory, the drill approach was demonstrated to be inferior.

Jenks, S.M. and Pecks. D.M. Mental imagery in mathematics. AT,1972, 12, 642-644.

Jenks, S.M. and Pecks, D.M. Why blame kids ? We teach mistakes ? AT, 1980, 11, 38-42.

Jenks, S.M. and Pecks, D.M. Share and cover. AT, 1981, 3, 38-41.

Kieren, T.E. On the mathematical , cognitive and instructional foundations of rational numbers. In R.A. Lesh (Ed.) Number and Measurement, ERIC/SMEAC, Ohio State University, 1976.

Kieren, T.E. Knowing rational numbers- levels of representations and symbols,In M.M. Linquist (Ed) 1980 NSSE Yearbook, NSSE Chicago, 1980.

Larson, H.L. The sturcture of a fraction. AT,1966, 4, 296-297.

May Lola. Fractions for primary. GT, 1967,4, 52-54.

May Lola. How to give meaning to rational numbers. GT,1968,1,62-64.

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Miller, Ann. Teaching the concept of 1/2 in the primary grades. AT.1978,3,57-58.

Miller, G.H. How effective is the meaning method. AT, 1957, 3, 45-49.

Muller, F.J.. On the fraction as a numeral. AT, 1961, 5, 234-238.

Novillis, C.F. Four aspects of the fraction concept observed in selected sixth grade students. Unpublished Master's thesis. The University of Texas, Austin, 1969.

Pace, J. A rational approach to fractions. The Two Year College Mathematics Journal, 1978, 9, 3, 154-158.

Phillips, J.. On fractions. Instructor, 1967, 3, 121,152.

Polkinghorne, A.R. Young children and fractions. Childhood Education, 1935, 11, 354-358.

Rapport, D. The meaning of fractions. SSM, 1962, 62, 241-244.

Rudnitsky, A.N.. and Drickamer, P. and Handy, R. Talking mathematics with child. AT, 1981, 1, 14-17.

Scandura, J.M. Fractions-names and numerals. AT, 1964, 11, 468.

Scott, L. Children's concept of scale and the subtraction of fractions. AT, 1962, 3, 115-118.

Streefland, L. Some observational results concerning the mental constitution of the concept of fractions. Educational Studies in Mathematics, 1978, 9, 51-73.

Multiplication

Arvin, C.L. An experimental study of programmed instruction in multiplication of fractions. DA, 1966, 26, 7109.

He found no differences in achievement between children using programmed materials compared to those in regular classroom instruction, but programmed materials took only half the time.

Austin, G.R. A study of programmed instruction response styles and reinforcement schedules for teaching multiplication of fractions. DAI, 1966, 26, 5218.

He found no differences between treatments comparing multiple-choice answers versus written answers and 100% reinforcement versus 50% reinforcement.

Chabe, A.M. Rationalizing inverting and multiplying. AT, 1963, 5, 272-273.

Collier, M. Learning to multiply fractions. SSM, 1922, 4, 324-329.

Fehr, H. Fractions as operators. AT, 1968, 3, 228-237.

Haddah, M.S. An error pattern leads to a discovery lesson. MT, 1980, 3, 197.

Hoffman, H.W.. Meaning for multiplication of fractions. AT, 1958, 3, 89-90.

Lankford, F.G. Some computational strategies of seventh grade pupils. U.S. Office of Education, Project No. 2-C-018. Washington, D.C. Government Printing Office, 1972.

May, Lola. Multiplying fractional numbers. GT, 1968, 3, 26-30.

Miller, J.W. An experimental comparison of two approaches to teaching multiplication of fractions. JER, 1964, 469-471.

He designed materials with prompt feedback from pupils and found them superior to the regular text on a posttest.

Rappaport, D. Multiplication is repeated addition. AT, 1965, 11, 550-551.

Romberg, T.A. A note on multiplying fractions. AT, 1968, 3, 263-265.

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Trimble, H.C. Fractions are ratios too. ESJ, 1949, 11, 285-291.

Rate and ratio

Bidwell, J. From ratio to rational number. SSM, 1966, 10, 661-669.

Crumley, R.D. Teaching rate and ratio in the middle grades. SSM, 1960, 2, 419-426.

Johnson, J.T. Are ratios fractions. ESJ 1948, 3, 374-378.

Schmalz, R. The teaching of percent. MT, 1977, 4, 340-342.

She emphasized the use of a preproportion statement, which is an intermediate step by which any percent statement takes on a manageable form in teaching percent.

Steffe, L.P. and Parr, R.B. The development of the concept of ratio and fraction in the fourth, fifth and sixth years of the elementary school. Technical report no. 49, Wisconsin Research and Development for Cognitive Learning, OE 5-10-154, Madison, Wisconsin: The University of Wisconsin, 1968.

Research

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Anderson, R.C. A comparison of the two procedures for finding the least common denominator in the addition of unlike, unrelated fractions. DA,1966, 26, 5901.

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Babcock, G.R. The relationship between basal measurement ability and rational number learning at three grade levels. A thesis submitted to the Faculty of Graduate Studies and Research University of Alberta, 1978.

Bat-hee, M.A. A comparison of two methods of finding the least common denominator of unlike fractions at fifth grade level in relation to sex, arithmetic achievement and intelligence. DA, 1969, 29A, 4365.

He found that the factoring method and a process using rows of equivalent fractions were equally effective in teaching student to find the LCD; and both procedures were superior to the inspection method .

Bauer, J.L. The effect of three instructional bases for decimals on computation skills of seventh-grade students. DAI, 1975, 5, 35, 251A.

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She compared the effects of two instructional approaches: area and finding a part of, and two instructional materials: diagrams and manipulative aids on the teaching of multiplication of fractions with fifth graders. She found the following: 1. diagrams and materials were equally effective in learning multiplication of fractions. 2. When comparing the four treatments, the area-diagram approach was the best, with the part-of-material group ranking second. 3..An attitude test showed that pupils liked the diagram approach better than the manipulative approach.

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